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TECHNICAL MEMORANDUM

(TM Series)

Utility System Programming Proposals	SYSTEM
Proposal for Additional Features	DEVELOPMENT
In the LARII Assembly Program	CORPORATION
By	2500 COLORADO AVE.
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1 March 1963	SANTA MONICA
Approved	
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This document is one of a series of TM-890 volumes established for Utility
System Programming proposals.

Comments on this document must be received by 29 March 1963 to be reflected
in the final design criteria.

Proposal for Additional Features in the LARII Assembly Program

Processing of EQU Cards

Due to the nature of the present LARII assembler, all symbols must be defined
during a single pass through the source program. Since EQU cards define sym-
bols, they must be completely processed. So a symbol occuring in the M-term
of an EQU must be defined earlier in the deck than the EQU, or the symbol in
the location of the EQU will be undefined. The location of EQU cards in a
deck then is dependent on the symbol ordering of the program itself even though
EQU cards have nothing to do with the operational part of a program. This rule
is unnecessary and could be circumvented in the following way.

When the assembler finds an EQU which it can not evaluate it would save the
information needed in a table. At the end of pass one all the other symbols
in the program except possibly some of the EQU's would be defined. This table
would then be scanned, defining all of the symbols possible. When finally such
a scan of this table yielded no newly defined symbols, the rest must be unde-
fined. With this feature EQU cards could be placed anywhere in the deck with-
out regard to the location of the symbols which are contained in their M-term.

Expanded DUP Pseudo

The DUP pseudo is now limited to duping the following card only. This capa-
bility could be expanded to allow the duplication of the following N cards, M
times. The M-term could contain two expressions separated by a comma to define
N and M. This pseudo coupled with the VFD pseudo and the action of the element

asterisk in M-term arithmetic would allow the generation of almost any kind of a table.

Additions to the Index

The format of the LARII index which follows the listing of every program is: The location of every symbol which is not null, followed by the symbol itself (symbols are in alphabetical order), followed by the location of each cell which makes a reference to this symbol.

Each one of these references could be followed by a comma and one letter, which would give some sort of indication of the operation which was performed on the symbolic cell at the reference location.

The letter "L" would mean that this cell was loaded or entered into one of the central registers.

The letter "D" would mean that this cell was destroyed; that is, changed in some fashion.

The letter "T" would mean a transfer was made to this symbolic location.

The letter "U" would mean the cell was combined with a central register, e.g., added.

The letter "P" would mean this cell was used as a machine count, e.g., shift instruction.

The letter "B" would mean this cell contained a symbolic B-term reference.

The letter "Z" would mean this cell was referenced by a ZRO, NOP, SVN, or appears in a pseudo operation.

All EQU's and references made in the M-term of an EQU would be put in this index. A reference made by an EQU would be followed by an asterisk and the letter "E". The reference location would be the location counter at the time the EQU was encountered.

Each symbol defined by an EQU card would be put in the index. The symbol's value and not its location would go to the left of the symbol. An asterisk would appear between the value and the symbol. The value in the first reference location would be the location counter at the time the EQU was encountered, followed by two asterisks. All cells which referenced the symbol would follow in the usual manner.

At present null symbols are in a separate listing and their locations are not given. Null symbols could be inserted in the index along with their location and no references, of course.

Extended Error Checks

Due to the proposed additions to the assembly program the error checking ability would have to be amplified. The additional error flags and their meanings would be:

"R" error   - This M-term expression is neither relocatable nor absolute and would not be handled correctly at load time. An example would be A+B, where A and B are relocatable elements. The M-term is cleared to absolute zero.

"C" error   - Incorrect use of a special character in an M-term. The M-term is cleared to absolute zero and examination of that card ceases.

"V" error   - Division by zero has occured in an arithmetic expression. It is equivalent to division by one.

"N" error   - The symbolic B-term is undefined. It is defined as zero.

"G" error   - The B-term specified is greater than seven. It is calculated module eight.

"E" error   - Too many termporarily undefined EUQ cards. All those following must remain undefined. The limit would be about four hundred.

"P" error   - A pseudo instruction such as DUP or BSS has a relocatable M-term.
                It is defined as one. This error printout will also occur if
                a symbol is undefined when it is used in an ORG, DUP, BSS, but
                it is defined later. The ORG will get a value of 10000B. The
                DUP and BSS will get the value one. The symbol will be defined
                correctly and used as it is defined if it is referenced there-
                after.

"T" error   - The literal table is full. All references to literals which do
                not already exist in the table must go undefined. The limit
                on distinct literals is one thousand octals.

"K" error   - A reference has been made to a block which does not exist.
                The share area is searched (if one exists) and the symbol is
                undefined if it is not found there.

The number of errors is printed at the end of each listing. This could be
followed by the location of each error and its type in a format similar to
a symbol in the index. The number of errors and their locations (octal cell
in the program) would be apparent at a glance. The location of the sequence
errors could be recorded in this manner also.

Reference Symbols

The pseudos REF, REFD, and REFC allow one to alter the reference symbol table
at assembly time. If prestores are stacked, then a person must take the
symbol table as it remains, following the previous assemblies. The assembly
program is sure to have the original table only when it is read in anew from
the master tape.

The original table could be saved and restored before assembling the next
program if the previous program alters it. In this way, one would be assured
of the current symbols table regardless of job stacking, etc.

Heading Cards

The first two REM cards in a symbolic deck appear at the top of each page of the assembly listing. The identification information (columns 70-80) on these cards is also printed on each page. It could be eliminated since it serves no real purpose.

Additions to OCT and DEC Pseudos

The DEC pseudo recognizes the letter "D" for decimal scaling and the letter "B" for binary scaling. MTCII recognizes the letters "E" and "S" respectively for the same purpose. The assembly program would recognize all four letter in order to prevent errors resulting from confusion of the two programs.

If one wishes to insert an octal number in the higher bit positions of a word using the OCT pseudo, he must follow the number by a sufficient number of zeros to left adjust it appropriately. If the number is not to be left adjusted by a multiple of three bits, zeros are not sufficient and the bit pattern must be considered and a different number written which can be offset by a multiple of three bits, resulting in the desired bit pattern. The OCT pseudo could recognize a binary scaling factor. The octal integer would be followed by the letter "B" and this followed by a number between zero and forty-eight to specify the number of bits the octal integer is to be shifted to the left. The binary scaling factor (which follows the B) would be a positive integer with no sign term.

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System Development Corporation,
Santa Monica, California
UTILITY SYSTEM PROGRAMMING PROPOSALS
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Proposes additional features in the
LARII Assembly Program. States that

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were defined, these EQU cards could be
defined. Suggests that the DUP Pseudo
be expanded to allow the duplication of
the following N cards, M times. Indicates
that extended error checking capabilities
could be provided and the index could be
more complete.

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